

GRB 090417B and its Host Galaxy: A Step Towards Understanding Optically-Dark Gamma-Ray Bursts

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<http://lheawww.gsfc.nasa.gov/~sholland/index.html>

Introduction

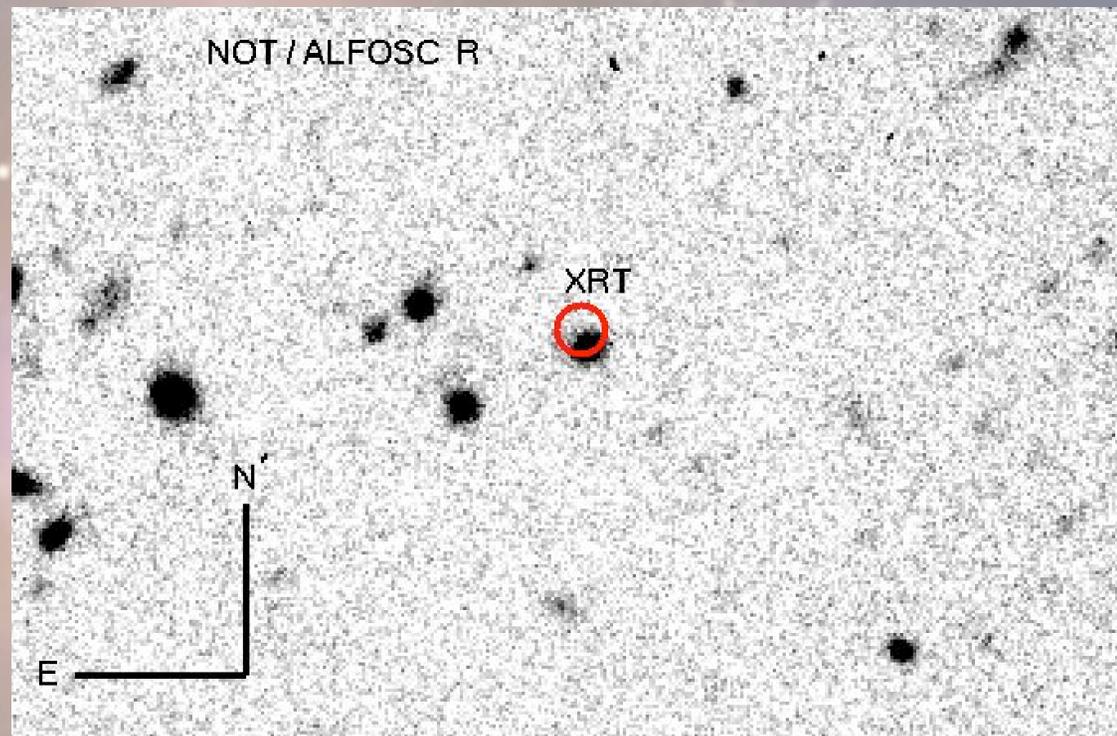
- GRB 090417B was a long–soft GRB detected by *Swift*; $T_{90} > 2130$ s.
- Several observatories observed it, but *no optical or infrared afterglow was found*.
- An SDSS galaxy at $z = 0.345$ is $1.08''$ (5.3 proj. kpc) from the centre of the XRT error circle ($r = 1.4''$).

The Host Galaxy

$$P_{\text{ch}} \approx 10^{-3}$$

One of the most secure host identifications.

Luminosity and size are consistent with hosts of optically-bright GRBs.

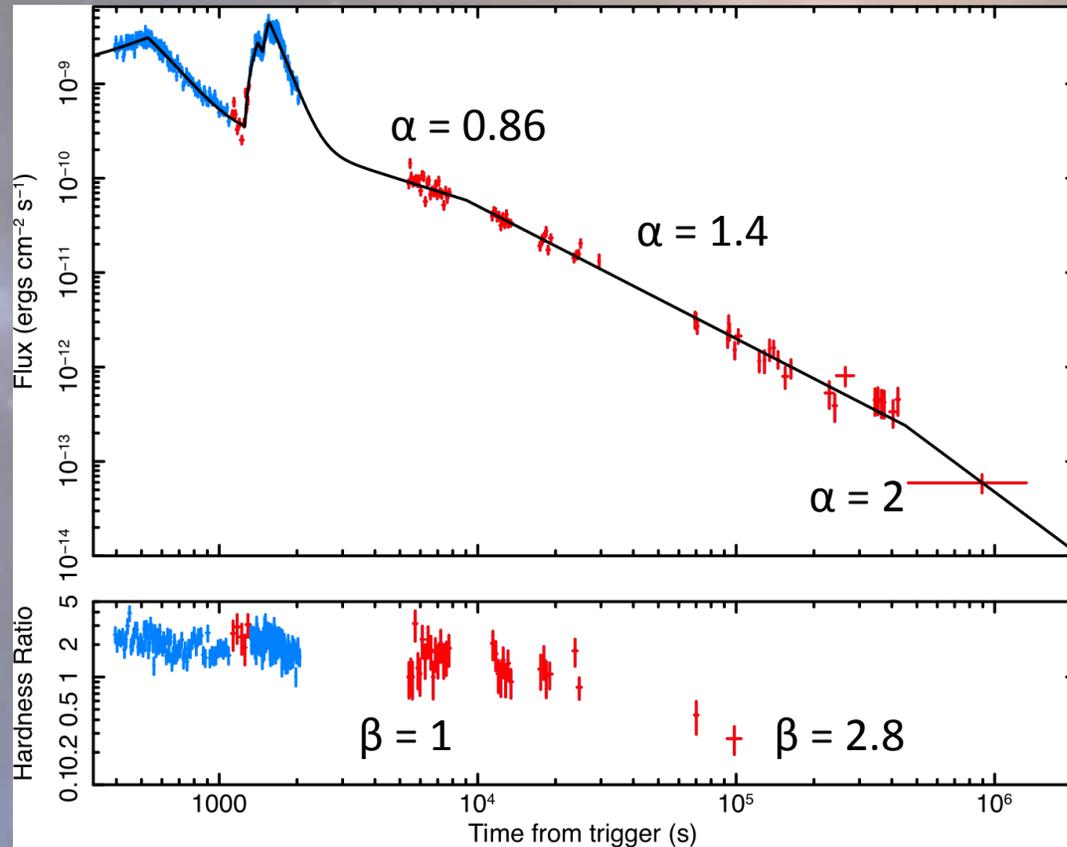


Dust: Optical data \rightarrow Milky Way extinction law, $A_V = 3.5$ mag, more than typical host of optically-bright GRBs

Luminosity: $(M_B)_{\text{AB}} \approx -20.3 \rightarrow \mathcal{L} \approx 1.3 \mathcal{L}_B^*$, comparable to the Milky Way

SFR: $> 1 \mathcal{M}_{\text{sun}} \text{ yr}^{-1}$, perhaps as high as $10^2\text{--}10^4 \mathcal{M}_{\text{sun}} \text{ yr}^{-1}$

The Afterglow



Normal X-ray light curve
Follows canonical light curve

Spectrum gets softer with time

Can not explain this with
synchrotron emission

Dust

GRB 090417B is a Dark Burst

$\beta_X = 1.3$ (11 hr) \rightarrow typical

$\beta_{OX} < -1.9$. (11 hr) \rightarrow dark

X-ray flux at 11 hr $\rightarrow u < \approx 21.7$

But observed $u = 23.09$ (host+OA)

The Early Afterglow

X-ray decay and spectrum before ≈ 8 hr
consistent with relativistic fireball

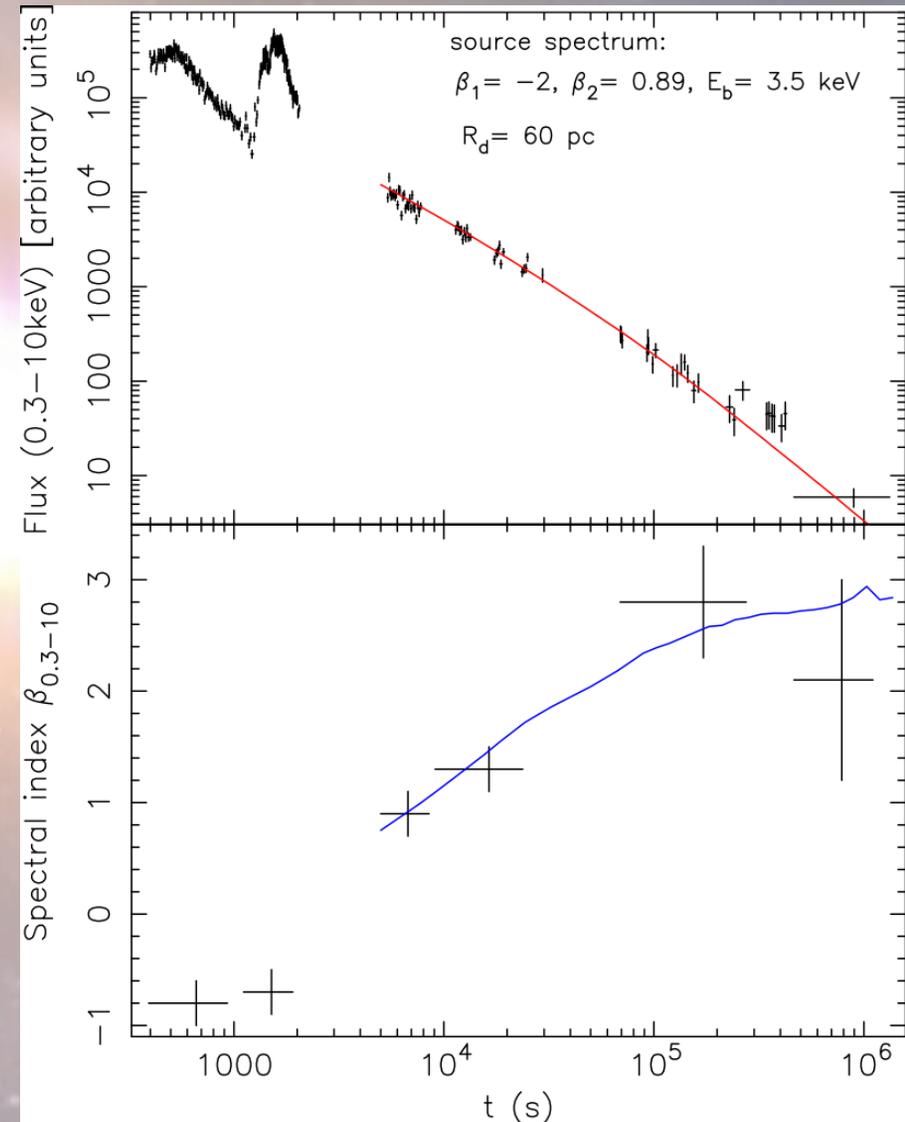
Dust Scattering

Late-time X-ray spectrum \rightarrow dust scattering
(Shao & Dai, 2007)

Sheet of dust 30–80 pc from the burst

$A_V \approx 15\text{--}40$ mag (predicted)

$N_H \rightarrow A_V = 11$ mag (from X-ray spectrum)



Conclusions

- GRB 090417B was a dark gamma-ray burst.
- GRB 090417B was dark due to dense, localized dust along the line of sight.